

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads; and

each contact comprising a bump and a plurality of spaced raised portions projecting from the bump with a height, the raised portions dimensioned to penetrate into a pad at the force to a penetration depth equal to the height but less than a thickness of the pad, the bump dimensioned to limit further penetration of the raised portions into the pad at the force.

79. (five times amended) The apparatus of claim 78 wherein the bump is dimensioned to penetrate into the pad at a second force which is about two to ten times the force.

80. (five times amended) The apparatus of claim 78 further comprising a plurality of conductive traces on the substrate in electrical communication with the contacts, and a plurality of external contacts on the plate in electrical communication with the traces.

81. (five times amended) The apparatus of claim 78 wherein the height is about 5000Å.

82. (five times amended) The apparatus of claim 78 wherein the pads comprises bondpads.

87. (five times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

- a plate comprising a plurality of external leads;
- a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;
- a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump and a plurality of spaced raised portions projecting from the bump with a height, the raised portions configured to penetrate into a pad with a penetration depth equal to the height but less than a thickness of the pad while the bump limits further penetration, the force selected to be greater than a first force at which the raised portions penetrate the pad but less than a second force at which the bump penetrates the pad, the second force being from two to ten times the first force.

88. (four times amended) The apparatus of claim 87 wherein the height is at least 5000Å.

90. (four times amended) The apparatus of claim 87 wherein the bump comprises a surface and the raised portions project from the surface.

91. (four times amended) The apparatus of claim 87 further comprising a plurality of bond pads on the conductive traces.

92. (four times amended) An apparatus for testing a semiconductor die having a plurality of pads comprising:

a plate;

a substrate on the plate comprising a plurality of contacts configured to electrically contact the pads;

a clamping mechanism attached to the plate configured to bias the contacts and the pads together with a force;

the plate, the substrate and the mechanism configured such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between

the mechanism and the substrate with the contacts in electrical contact with the pads;

each contact comprising a bump having a surface and a plurality of spaced raised portions projecting from the surface dimensioned to penetrate into a pad at the force by a penetration depth equal to a height of the raised portions but less than a thickness of the pad while the surface limits further penetration into the pad, the force selected to be greater than a first force at which the raised portions penetrate the pad but less than a second force at which the bump penetrates the pad.

93. (four times amended) The apparatus of claim 92 further comprising a plurality of external leads on the plate in electrical communication with the contacts.

96. (four times amended) The apparatus of claim 92 wherein the raised portions comprise points.

97. (added) An apparatus for testing a semiconductor die having a pad with a thickness comprising:

a plate;

a substrate on the plate comprising a contact configured to electrically contact the pad, the contact comprising a bump having a surface and at least one raised portion projecting from the surface with a height, the raised portion and the surface configured such that the raised portion can penetrate into the pad to a penetration depth equal to the height but less than the thickness while the surface limits further penetration into the pad; and

a clamping mechanism attached to the plate configured to bias the die and the substrate together with a force selected to achieve penetration of the pad by the raised portion but to prevent damage to the pad by the bump.

98. (added) The apparatus of claim 97 wherein the contact comprises a plurality of raised portions and the raised portions comprise pointed members.

REMARKS

Rejections Under 35 USC §103

Claims 79-82, 87, 88, 90-93 and 96 have been rejected under 35 USC 103(a) as being unpatentable over Malhi et al (US Patent No. 5,088,190) or Elder et al (US Patent No. 5,123,850) in a first set, in view of Nakano (JP Hei 3-69131) in a second set, and Blonder et al. (US Patent No. 4,937,653) or Bindra et al (US Patent No. 5,137,461) in a third set.

Claims 78-82, 87, 88, 90-93 and 96 have been rejected under 35 USC 103(a) as being unpatentable over Nakano in a first set, in view of Blonder et al. or Bindra et al. in a second set.

The 35 USC §103 rejections are respectfully traversed for the reasons to follow.

Argument

Malhi et al. '190 and Elder et al. '850 were cited as disclosing test apparatus similar to the present test apparatus. Nakano was cited as teaching a penetration limiting contact. Blonder et al. and Bindra et al. were cited as teaching plural raised portions on a contact structure.

Applicant would first argue that the references do not teach an apparatus for testing a semiconductor die in which a contact structure is designed to achieve penetration, and also penetration limitation, as a function of a biasing force applied by a clamping mechanism of the apparatus. Specifically, the present claims recite a contact in the form of a bump having raised portions configured to penetrate the pads on the die at the biasing force, and a surface on the bump configured to limit further penetration at the biasing force.

Admittedly, clamping mechanisms have been used in testing apparatus for semiconductor dice. However, at the time of the present invention the biasing force exerted by the clamping mechanism was a major issue. An insufficient biasing force prevents reliable electrical connections from being made. On the other hand, too much biasing force damages the pads on the dice under test.

In this regard the Office Action states that: "One skilled in the art would apply a force sufficient to make good contact and not so great as to destroy that being tested." However, prior art contacts such as the bumps 331, 332, 333, 334 in Figure 3 of Malhi et al., or the bumps 24 in Figure 3 of Elder et al., cannot make good electrical connections without destroying at least some of the pads on at least some of the dice under test. Specifically, good electrical connections require penetration of oxide layers on the die pads, and the bumps in Malhi et al. and Elder et al. cannot penetrate without large biasing forces. Accordingly large and destructive biasing forces are required to achieve good electrical connections using the bumps in Malhi et al. and Elder et al.

Although Nakano et al. teaches a penetration limiting contact, there is no teaching of relating a biasing force applied by a clamping mechanism to the structure of the penetration limiting contact. Specifically, Nakano et al. is directed to a probe card, such that the biasing force for biasing the contact with the dice on the wafer can be externally generated by something other than a clamping mechanism (e.g., movement of the wafer or the probe card by a hydraulic cylinder or a press).

*this is
a clamping
mechanism*

In this regard the Office Action states "Anything that is held together is clamped. The size of the clamp is not relevant." However, the present claims place specific limitations on the structure and function of the clamping mechanism. For example, independent claims 78, 87 and 92 state: "the plate, the substrate and the mechanism configured

such that the die can be placed on the substrate, the mechanism attached to the plate, and the die retained between the mechanism and the substrate with the contacts in electrical contact with the pads". Although such a clamping arrangement is known in the art, this arrangement in combination with a contact configured to penetrate, and to limit penetration, as a function of biasing force applied by the clamping mechanism is not suggested by the art.

With respect to Blonder et al. and Bindra et al., these references teach plural points in the context of bonded connections rather than in the context of a testing apparatus as presently claimed. Accordingly one skilled in the art would have no incentive to combine these references with Malhi et al. and Elder et al. Further, there is no suggestion in either Blonder et al. or Bindra et al. of penetration, and penetration limitation, as a function of biasing force applied by a clamping mechanism.

In addition to not teaching all of the presently claimed features in a test apparatus, Applicants would argue that there is no incentive in the references, or in the art, to combine the references in the manner of the Office Action. In this regard the Office Action states "It would have been obvious to one of ordinary skill in the art at the time the invention was made to have adapted the contact structure of the second set modified to have plural raised portions in accord with the third set to the apparatus of the first set because one of ordinary skill in the art would realize that so doing would result in better contact being made".

However, it is submitted that this statement results from a hindsight reading of the present disclosure rather than from any teachings in the references or the prior art. Such an analysis has been referred to be the Courts as "improper hindsight". See for example, W.L. Gore & Associates v. Garlock, Inc., 721 F.2d, 1540, 220 U.S.P.Q. 303 (Nov. 14, 1983).